APPLICATION OF REMOTE SENSING IN ENVIRONMENTAL STUDIES: A THEORETICAL REVIEW

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Abstract:
The present research aims to perform a descriptive analysis of remote sensing and its applications in the various fields of human knowledge; although scientific and technological progress has indeed shown to reach an important development in the dynamics of natural and anthropic processes, which allows understanding their effects fully; thus, on that basis, multiple studies are conducted in the fields of spatial sciences, agriculture, geology, edaphology, oceanography, risk and disaster prevention, mining exploration, among others. Thus, this area of knowledge offers great potential for strategic planning, decision-making, and the development of environmental projects considering biodiversity and environmental sustainability. Consequently, remote sensing offers many possibilities for scientists and researchers to broaden their field of action and become familiar with the photo-interpretation of satellite images, which is very necessary for scientific work today. In the methodological part, documentary information, research works, scientific articles and environmental development projects supported the research developed.

Keywords: Remote sensing, sensor systems, technological applications, environmental sustainability.

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INTRODUCTION

In the present research, researchers such as: Calzada (2016), in his study, had the purpose of identifying the possibilities of using remote sensing data for the localization of specific locations that have geothermal potential using L7ETM+ satellite images. In this sense, the use of remote sensing in the thermal infrared electromagnetic band makes it possible to estimate the temperature level of terrestrial areas in which the technical parameter is a determining indicator of the existence of geothermal resources. Likewise, the interactive processes between regional geology, geothermal activity, and remote sensing as an instrument of terrestrial exploration make the elaboration of studies in the diagnostic stage to identify geographic regions with geothermal potential. That is why remote sensing provides valuable information from the remote optics that pinpoints the location of geothermal resources; since, through the investigation, it is possible to establish criteria in the processes of creation, generation, transmission and distribution of electric energy sustained in the geothermal resources in the fields of La Soledad, Jalisco and Los Negritos, Michoacán that conform the Trans-Mexican Volcanic Belt. Also, the researchers, Veneros, J., García, L., Morales, E., Gómez, V., Torres, M. and López-Morales, F. (2020), in their research had as a purpose the evaluation of remote sensors for the study and analysis of vegetation cover and water bodies for environmental conservation. In this sense, satellite images are essential since they allow it to analyze forest cover, urban growth, vegetation levels, variations in vegetation cover, deforestation, water resources, lagoon dynamics, and water quality indexes. Therefore, it was concluded that, through satellite images in small to

medium-scale studies, very valuable information could be obtained on the conservation of natural resources and their impact on terrestrial dynamics.

In work carried out by Cosme (2020), the purpose was to process satellite images to characterize mining soils in Peru. It is possible to obtain information on metric tons to be processed using digitization technology and identify certain sets of hydrothermal alteration mineral resources such as ferric minerals and clays through satellite images. According to the studies carried out in Chile, satellite images were analyzed and the number of metric tons allowed to determine important copper (Cu) mining deposits in the geographic regions of Collahuasi and Ujina; therefore, hyperspectral images facilitate the specific identification of iron and clay. Furthermore, remote sensing has become very valuable in the exploration activities of mining deposits; since these are located along with regional and local geological fractures; thus, Landsat and radar images are used to map such fracture patterns. Likewise, Marzialetti's (2012) research on monitoring oil spills in water bodies. In the current context, it is observed that the significant increase in energy resources; thus, it is notorious for the increase in the exploration of basins with hydrocarbon potential; in this sense, remote sensing techniques can be used to provide support in areas such as remote sensing and monitoring of spills due to accidental causes or those that are attributed to operational activities such as the application of SAR technology. Consequently, a major acute problem of enormous extensions is pollution due to oil spills, representing one of the greatest threats to marine biodiversity, producing the degradation and alteration of ocean ecosystems and directly affecting the variety of hydrobiological species and coastal birds.

The definition of remote sensing is recognized as a scientific discipline that is essentially constituted by the observation, exploration and monitoring of the terrestrial geoid; in this sense, for such purposes, electronic sensors are used for the capture of electromagnetic radiation in its different bandwidths of the spectrum, making it possible to characterize multiple facts or phenomena that occur in the landmass, in turn, it is a source of the first order for the estimation of biophysical variables in the research field (Calzada, 2016). The remote sensing system is made up of multiple components that interact with each other, for this a base of this system is required, which is a source that generates electromagnetic radiation in its natural form as the Sun or an artificial type that emits radio waves, being essential this source for the capture through sensors, the signal that is reflected from the land surfaces that information is desired; It should be noted that the sensor systems are positioned on space platforms such as artificial satellites, this information is transmitted to a system of receiving stations for processing and digital treatment of the study area (Chuvieco, 2008).

The importance of remote sensing, in this era of constant changes in the natural and anthropic environment, it is necessary to conduct studies to understand the phenomena that affect the environment and their impact on the dynamics of ecological processes; that is why technologies are required to provide sufficient information for decision making, strategic planning and biodiversity conservation policies that are currently very affected and require attention from government authorities. Thus, remote sensing provides a set of techniques for obtaining spatial, temporal, and spectral information using sensors that collect energy flows from electromagnetic spectrum bands for interpretation (Murillo and Carbonell, 2012). Sensors for remote sensing are considered electronic systems that are basically classified, considering the source of energy radiance as a criterion and divided into passive and active. In that sense, the passive sensors are in charge of detecting the radiation that the Sun reflects or is emitted by the bodies located on the terrestrial surface; these depend essentially on an external source of radiation to operate. Likewise, active sensors produce their own radiation; among these, we have the radar as a system that generates its own sufficient energy to interact with the bodies

located on the earth's surface (Villegas, 2008). The information received by these is recorded on tapes compatible with computer CCT, satellites such as SPOT and Landsat TM capture information from the earth's surface by linear scanning.

The electromagnetic spectrum is associated with energy from a source in the form of electromagnetic waves and is called electromagnetic radiation. This radiation can be of natural or artificial origin. Therefore, the electromagnetic spectrum is the set of all possible frequencies (number of wave cycles per unit of time) at which electromagnetic radiation is produced. Thus, the spectral fingerprint captured by remote sensors reflects the behavior of the multiple objects analyzed based on the greater or lesser capacity for absorption, transmission or reflection of the energy received (Lillesand and Kiefer, 2000; Chuvieco, 1995; Ormeño, 1993). In the world in which we live, we increasingly observe the need to understand the dynamics of the planet Earth with the multiple phenomena that converge in it and serve as important elements to carry out multiple investigations in the most diverse fields of scientific knowledge. Thus, in these times of great boom in satellite technology and remote sensing, humanity is in a position to study the most varied situations of the biophysical world and reach a better understanding to implement projects with a sense of sustainability and environmental conservation through the use of computational architectures, photointerpretation systems, remote sensors, among others (Lira, 2021).

METHODS

The research is of non-experimental design, descriptive design; in which a literature review was carried out in terms of remote sensing and its applications in environmental studies. It consisted of an analysis of the information of the work variable and knowing the scientific and technological foundations. We worked with scientific articles whose objective was the application of remote sensors and multispectral range satellite images.

RESULT AND DISCUSSION

The research results allowed us to obtain the information on Remote Sensing in: Agriculture and soil conservation. Remote sensing has an enormous potential for its application through concurrent disciplines that serve as a basis for decision making, as in the case of the agricultural sector, which enables the detection and evaluation of certain limiting natural factors, the identification of crop types, inventories of natural resources, plant growth, plant vigor, nutrient needs, spatial dynamics of productivity, estimability of biomass and its yield level; It is also necessary to analyze crop surfaces and sample the physical, chemical and biological properties of the soil in the terrestrial environment using satellite imaging techniques. Likewise, the availability of information for researchers and farmers in understanding remote sensing in terms of spatial, spectral and radiometric resolution is imperative (Aguilar, 2015). In remote sensing, the reflectance spectrum of adult and healthy plants in the visible is characterized by strong absorption (low reflectance) in the blue (400-500 nm), an increase in reflectance in the green (500-600 nm), as a maximum peak at 0.54 nm and does not exceed 20% of the total incident radiation (Yoder and Pettigrew-Crosby, 1995); absorption in the red (600-700 nm) and strong reflectance and transmittance (50%) in the near-infrared plateau (700-1 500 nm). As well as the application to forestry, nowadays, forest resources require a set of specific processes, which involve decision making, organization, planning, control and administration. In this sense, it is known that forest ecosystems provide a series of environmental benefits such as timber, fodder, water regulation, recreational spaces, carbon sequestration, protection of soil resources and biodiversity conservation. That is why satellite images are of great support in the forestry sector in terms of cartographic mapping and identification of various types of forests; it is also widely used to determine the stages of growth, regeneration and

successional phases, changes in vegetation, among other aspects of forest valuation (Ancira and Treviño, 2015).

The application to bodies of water is currently of great interest to researchers, such as the state of eutrophication of water, which is a fundamental concern, since it can generate a significant increase in the level of turbidity and a change in color to a greenish trend, precisely due to the increase of phytoplankton, as it could alter the ecosystem of lagoons (Moncayo and Bueno, 2016). In this sense, it is essential to monitor the water quality level, which is why remote sensing could be used to obtain data without being intangible contact with the natural environment; this is possible with the use of remote sensing sensors in real-time (OECD, 1982). In addition, the resolution of the OLI sensor (30 meters/pixel), is the most appropriate for water quality studies and to analyze certain specific variables; it is worth noting that, the OLI sensor makes it possible to monitor the quality of water bodies such as the level of transparency, suspended particles and chlorophyll levels in the water (Doña, Sánchez, Caselles, Domínguez and Camacho, 2014). Likewise, the application to oceanography and marine resources, remote sensing is of great interest in the process of satellite measurements of ocean color since it contributes significantly to the quantification of both spatial and temporal variability of different biological and physical processes; CZCS, SeaWiFS, MODIS and MERIS technologies are used for this purpose. Likewise, the contribution of remote sensing techniques for evaluating the trophic status of marine systems is currently being valued; thus, ocean color is par excellence one of the properties to be measured by remote sensors and as an oceanographic parameter that allows the characterization of the ocean surface. Therefore, in the vast ocean, water and pigments are known to be the primary components; chlorophyll is typically derived using the spectral regions corresponding to blue (0.4-0.5 μm) and green (0.5-0.6 μm). Chlorophyll pigments absorb wavelengths ranging from blue (455-492 nm) to red (622-700 nm) of the electromagnetic spectrum; in turn, a strong reflectance is observed in the green color (492-577 nm) incident on the color of the ocean (Lara, 2009). Therefore, the application to glaciology and glacial retreat is crucial to monitor the changes in glaciers, since they represent one of the most significant indicators of temperature variation on our planet. It is known that the process of glacier melting has as one of the factors in the phenomenon of global atmospheric warming. In this sense, the acquisition of information from glaciers, without being in physical contact, is possible through the analysis and photointerpretation of the reflected energy source of the multiple components that constitute the terrestrial regions; thus, working with satellite images and remote sensors, it is feasible to determine the geometric dimensions in which glaciers are distributed; also, the values of surface temperature, reflectance, albedo, among other aspects, can be obtained (Caneleo, 2010). (Caneleo, 2010).

Concerning the application to mineral exploration, remote sensing proved to be very valuable for exploring mineral resources; it is known that certain mineral deposits are found along with certain regional and local geological fracture patterns that enable mineralization processes. In that sense, Landsat and radar images are used in the mapping of fracture patterns; such as hydrothermally altered rocks that are associated with varied spectral characteristics and can be digitally processed; that is why, multispectral infrared systems show great potential in mineral prospecting in the region (Cosme, 2020). As well as the application to the prevention and evaluation of natural disasters, natural disasters are facts or phenomena that express the terrestrial geodynamics; these events are produced by the action of factors of the tectonic plates and have a significant impact on the lithosphere such as earthquakes, volcanic activity, tsunamis and other aspects. That is why it is necessary to know about these activities that generate natural disasters; that is why it is evident to choose certain remote sensors that deliver valuable data for decision

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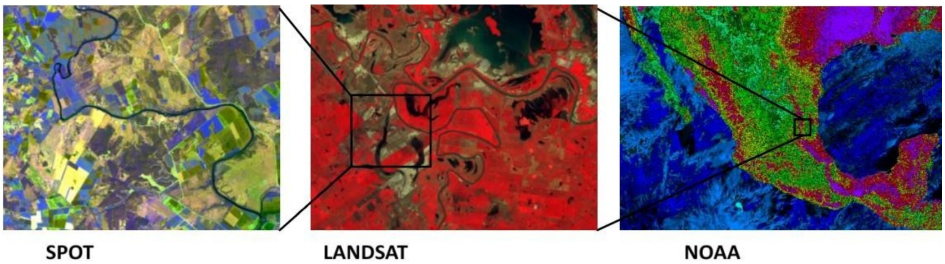
making. Thus also, the utility basically focuses on mapping the damage caused by the aforementioned natural phenomena, since, through satellite images, indispensable information would be provided; thus, mapping geographical areas and mitigation and response actions to such eventualities of nature would be carried out (Staub & Bähr, 2014). Some passive sensors used in this case are: (i) ALOS-PALSAR of range 7-100 m; L-band (1.27 GHz), which generates 3D maps, flood extent and damage assessment; (ii) Radarsat-2 of range 3-100 m; C-band (5.405 GHz), generates 3D maps, pollutant detection, flood extent and damage assessment; (iii) TerraSAR-X, range 1-16 m; X-band (9.65 GHz), generates 3D maps, landslide detection and monitoring of risk areas; and (iv) TanDEM-X, range 1-16 m; generates terrestrial relief models. Also of great interest is the application to oil spills at sea; the remote sensing of vessels, in the specific case of oil spill monitoring, will allow immediate actions in response to the damage caused at sea; Thus, a series of projects have been developed worldwide concerning vessel monitoring, and their effectiveness has been demonstrated, among which we can mention the Kongsberg Satellite Services (KSAT) service of Norwegian origin, the Italian Coast Guard Satellite-based maritime awareness and surveillance (ITCG) and the international Detection and Classification of Maritime Traffic from Space (DECLIMS) (Marzialetti, 2012). These include the conjunction of data from SAR images with other maritime traffic services such as VMS (Vessel Monitoring Systems) or AIS (Automatic Identification Systems). Finally, the application to epidemiological surveillance**,** remote sensing is considered as a tool that has several benefits, especially to expand epidemiological research and its application to phytosanitary problems, since, due to environmental information and its impact on the occurrence and distribution of pests; It also provides indicators of climate, soil delimitation and its changes due to natural or anthropogenic reasons, remote sensing of habitats, plant cover and vigor to determine their ecological situation. It also allows the characterization of environmental conditions in which pests are generated; therefore, it is feasible to build predictive models of risk areas with the mitigating factor of being considered as potential in the affectation of disease-transmitting organisms and the respective pathologies (Rivas, Díaz, Borruel, Perovan, 2009).



Source: SINAVEF

CONCLUSION

Remote sensing is one of the most efficient technologies to carry out powerful studies for researchers since it provides a support based on satellite images; therefore, it has a high potential for its application in various fields such as space research, agriculture, oceanography, mining, glaciology, disaster prevention, among others. Furthermore, the use of remote sensing has more and more uses, since the study of the earth employing satellite images such as Sentinel, Lansat, Aster, has allowed us to identify how gradually the effects of climate change have been advancing, being the case of soil desertification, one of the factors studied, where by means of satellite images it has been demonstrated how the areas that lose vegetation cover and become desert areas have increased (Pineda, 2011).

Another use of remote sensing applied to the Peruvian Andes is how the effects of temperature increase have accelerated the advance of glacier deglaciation in

various parts of the earth, such as the Andes and the arctic and Antarctic zones, Another factor that has been widely studied is the advance of deforested areas through indiscriminate logging, which has a direct influence on the loss of vegetation cover, which reduces carbon capture and consequently increases the amount of carbon dioxide in the air, It is in this sense that remote sensing is being increasingly used in the study of multiple factors that impact our planet directly and indirectly linked to climate change, in this sense, remote sensing is providing compelling information for the study of multiple phenomena that occur on the planet that impact the lives of the beings who live in it, who in turn see how environmental changes or episodes occur and seek ways to find out why they happen and how we can cope with them, generating resilience and adaptation.

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